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On the Laws of Mortality and Sickness of the Labouring Classes of England. By THOMAS ROWE EDMONDS, Esq., Actuary to the Legal and General Life Assurance Society.

THE mortality, according to age, of the general population of England in all localities, was first satisfactorily determined for the period of seven years, ending with the year 1844. The observations and results were published by the Registrar-General in the year 1849; and in the following year I was allowed the opportunity of exhibiting in *The Lancet* (vol. i. 1850, pp. 297–330) the principal results in new combinations, with my conclusions therefrom. The knowledge thus obtained of the mortality of the general population (with distinction of town from country districts) is valuable for testing the correctness of independent observations made on the mortality of classes of the labouring population, such as are contained in “Friendly Societies,” whose mortality and sickness it is now proposed to discuss.

Within the last few years, a very great addition has been made to the previously existing small stock of observations on the mortality and sickness experienced by members of Friendly Societies. In *The Lancet* of April, 1839 (vol. i., p. 185), was published an observation made by me on the members of a metropolitan Benefit Society, in which observation was comprehended the deaths and sickness, distributed according to age over 30,000 years of life. At that time there existed only two similar observations—one of these was contained in the report of the Highland Society, and embraced 85,000 years of life; the other was made by Mr. Ansell, and embraced 25,000 years of life. Since the time mentioned, we have had large additions made to this department of knowledge, from three sources, to the extent of two and a half millions of years of life observed. The first of these additions is due to Mr. Neison, and embraces more than one million years of life, observed during the five years ending with 1840. The next addition proceeded from a very large Friendly Society, called the “Manchester Unity of Odd Fellows,” and embraced about 600,000 years of life, observed during the three years ending with 1848—this observation having been made by the corresponding secretary of that Society, Mr. Ratcliffe. The third and last addition to this department of knowledge has been made by authority of the British Government, the results having been published within the last half year. Mr. Finlaison, jun., has been employed to make this observation, which extends over the five years ending with 1850, and

embraces about 800,000 years of life. This last observation, like that of Mr. Neison, is founded on official returns, which all registered Friendly Societies are required by Act of Parliament to make once every five years.

The three observations on Friendly Societies, made respectively by Mr. Neison, Mr. Ratcliffe, and Mr. Finlaison, jun., yield each its specific law of mortality and sickness. The three laws of mortality obtained are in accordance with the general law, which in all other observations regulates, in adult life, the increase of mortality according to age. The general law is this—that the rate of mortality increases, from puberty to the age of about 53 years, at the rate of 3 per cent. (.02991) for every advance of one year in age; and after that age, increases at the rate of 8 per cent. (.07969) for each year of age until the end of life. There exist innumerable specific laws of mortality, appropriate to particular masses of population; but all these specific laws differ from each other only in two characteristic points—one characteristic being the particular age at which the period of “florescence” terminates and the period of “senescence” begins, and the other being the absolute mortality at any specified age.

Previously to the publication of the three observations now under consideration, there existed grounds for believing that, in adult life, the increase according to age in the amount or duration of sickness suffered in each year of life was regulated by the same two numbers which regulate the increase of mortality in the periods of “florescence” and “senescence” respectively. In the year 1832, I published sickness tables, founded upon such unity of law. The present three observations confirm the view then acted upon, and may be said to establish the fact of identity between the constants of mortality and the constants of sickness. There is, however, a remarkable discrepancy between the three observations as to the particular age at which the period of florescence is divided from the period of senescence. In the three observations on mortality, and the three observations on sickness, the limiting age is either at 53 years or at 46 years. According to Mr. Finlaison’s observation, the limit dividing the two periods is at the age of 53 years, both for mortality and sickness; according to Mr. Ratcliffe’s observation, the line of separation is at the age of 46 years, both for mortality and sickness; but according to Mr. Neison’s observation, the limits of division for mortality and sickness are different, that for mortality being at 53 years, and that for sickness being at 46 years of age. This difference of seven

years in the position of the limit dividing the period of florescence from that of senescence, occasions a difference of 40 per cent. in the relative mortality or relative sickness at ages above 53 years compared with ages below 46 years. For example: assuming (as is not far from the truth) the mortality and sickness stated by all three observers to be equal at ages below 46 years, it will ensue, from the difference in the position of the limits just mentioned, that at any specified age above 53 years the mortality observed by Mr. Ratcliffe is 40 per cent. greater than the mortality observed by Mr. Neison and Mr. Finlaison, and that the sickness observed by Mr. Ratcliffe is equal to that observed by Mr. Neison, but 40 per cent. greater than the sickness observed by Mr. Finlaison.

The discrepancies just mentioned are of such magnitude as to detract considerably from the value of the results of all three observations at any age exceeding 53 years. In order to extract a useful result from the apparently contradictory observations, it is necessary to devise some principle of reconciliation which will explain the inconsistencies. Such a principle is found in the assumption, that one particular class of facts has been treated in three different ways by the three observers, whether designedly or not. The class referred to is that of members retired on the superannuation or sick pension list. It appears highly probable that Mr. Ratcliffe, in his observation, has treated all on this list as sick, and added their deaths to the general amount of deaths. On the other hand, it appears highly probable that Mr. Finlaison has treated nearly the whole of this class as pensioners in good health, and removed them from observation, whether as regards sickness or mortality.* To reconcile the third observation with the two just mentioned, it is necessary to assume that Mr. Neison has designedly reckoned all superannuation-time as sick-time; and that he has unavoidably omitted the deaths of the same class of members, because they were omitted in the returns from Friendly Societies submitted to him.

It may be useful here to remark, that Friendly Societies in general make these returns very reluctantly, and are careless as to their correctness or completeness. A very large proportion of the total returns from these Societies has been rejected by Mr. Neison and Mr. Finlaison as unavailable, through obvious defects arising from negligence, wilful or otherwise. As regards the adopted residue of the returns containing no obvious defects, the results which they indicate cannot be entitled to much confidence, unless

* The interpretation here suggested of "sickness" has been confirmed by Mr. Finlaison, in the second part of his official report, since published.

they are consistent with one another, and corroborated by other observations founded upon facts better attested. It is fortunate for the public that there exists such an extensive and well authenticated observation as that of Mr. Ratcliffe, with which can be compared the observations of Mr. Neison and Mr. Finlaison. From his position in connection with the "Manchester Unity," we have, in Mr. Ratcliffe, responsibility for facts as well as conclusions; whilst Mr. Neison and Mr. Finlaison are responsible for arithmetical conclusions only, founded upon alleged facts, whose correctness they had no power of testing.

There is another way of treating the discrepancies mentioned, which is, to assume that the statements of all three observers are of equal weight, and that the true statement is the mean of all three statements. This plan of proceeding is found highly successful, as will be seen on inspection of Table III. (p. 145). It will there be perceived that the results of the combined observations can be closely represented by assuming the age of 48 years to be the point of separation of the period of "floreescence" from that of "senescence," for mortality as well as for sickness. Out of twenty-four points of comparison of sickness and mortality, at decennial intervals of age, there will be seen twenty-three points of agreement; whilst the only point of divergence (which is, in "city" mortality, between the ages of 55 and 65 years) is a specialty hereafter explained, in which all three observations agree in departing from the theoretical numbers.

In the "Manchester Unity," at ages above 53 years, the mortality (shown in Table I., p. 143) is 15 per cent. greater than the mortality of the total male population of England. This higher relative mortality is such as might have been anticipated from this Society, containing less than the average proportion of members resident in rural districts, and more than the average proportion of members resident in town and city districts. According, however, to the observations of Mr. Neison and Mr. Finlaison, at ages above 53 years the mortality in Friendly Societies (containing the due proportion of rural, town, and city members) is 20 per cent. less than the mortality of the total male population of England. This is an unexpected result, which is open to doubt, more especially from the fact that there is a discrepancy in the statements of sickness at the same ages respectively made by Mr. Neison and Mr. Finlaison, which discrepancy, when converted into its proportional amount of deaths, would be just sufficient to make up the suspected deficiency of 20 per cent. The sickness suffered at ages exceeding 53 years is 40 per cent. greater, according to Mr. Neison, than it was according to

Mr Finlaison. The alleged mortality being equal in the two cases, it would follow that the sickness of a population can be greatly increased without the deaths being simultaneously increased—a conclusion opposed to all experience. It is nearly certain that the extra 40 per cent. of sickness observed by Mr. Neison represents the life-time of all superannuated members, which life-time is altogether excluded from his observation by Mr. Finlaison. If one half of all superannuation-time be true sickness, Mr. Neison's observation, as compared with Mr. Finlaison's, will contain an extra 20 per cent. of true sickness, without any extra per centage of deaths. If, however, an addition to the deaths (for omissions in the returns) be made, proportionate to the extra per centage of the true sickness observed by Mr. Neison, the resulting mortalities of all three observations will be in harmony with each other, and conformable to expectation.

It is also to be remarked, that if the mortality of members of Friendly Societies is influenced by "selection," as is probably the fact, there will be additional reason for doubting the truth of the statement in question; for the statement of Mr. Neison and Mr. Finlaison is, that in Friendly Societies the mortality in the period of florescence, as well as in the period of senescence, is 20 per cent. less than that of the total male population of England of the same age. The former part of this statement is probably true; but the latter part is inconsistent with the former part, and the known ordinary effects of selection of good lives from the general mass. In Friendly Societies the great majority of members are admitted below the age of 35 years; so that the effect of selection, being limited to about 15 years from admission, does not extend to the period of age exceeding 53 years. Assuming the reduction of 20 per cent. in the mortality during the period of florescence to be caused by "selection," there ought to be no difference, in the period of senescence, between the mortality of members of Friendly Societies and the mortality of the classes from which the members have been selected. It may be useful here to remark, that a reduction through selection of 20 per cent. in the mortality for the period of florescence is equivalent in appearance to a retrogression of four years in the limit at which the period of senescence commences. If, as is the fact, this limit in the total male population of England is at the age of 53 years, the corresponding position of this limit in Friendly Societies affected by selection in the degree mentioned would be at the age of 49 years.

In the three several observations the members are distributed into three classes, according to their residence in "rural," "town,"

or "city" districts; and the rates of mortality and sickness at different ages are separately stated for each class. The general result of all the observations is, that the mortality of the town is 25 per cent. greater than the mortality of the rural districts; and the mortality of the city 25 per cent. greater than that of the town districts. In Mr. Ratcliffe's observation, the mortality of the aggregate population is greater than the mortality of his town population; but in Mr. Neison's and Mr. Finlaison's observations, the mortality of the aggregate is considerably less than that of their town population. These variations are accidental, and arise from the absence of any settled principle regulating the distribution of the members into the three classes. Mr. Ratcliffe has distributed his numbers equally amongst the three classes of rural, town, and city residents, and has formed his rural class from residents of townships or parishes whose total population is less than 5,000 of all ages and both sexes. Mr. Neison (who has been followed by Mr. Finlaison) has distributed his numbers so that the rural, town, and city residents are in the proportions (nearly) of 4, 2, and 1, respectively; and Mr. Finlaison (with Mr. Neison probably) has formed his rural class from residents in townships or parishes whose total population is less than 3,000. Instead of these classifications, without any apparent principle, it appears to me that the preferable course would have been to comprehend in the "town" class about one half of the total numbers, and so to have adjusted the limits of magnitude of the places designated as "towns" as to render the mortality of the class resident in towns coincident in amount with the mortality of the aggregate population observed. Having thus fixed the intermediate "town class," the two extremes of rural and city classes would be simultaneously fixed. I acted upon the opinion now expressed, in forming a system of theoretical life tables, which I published twenty-two years ago. I divided the population into three classes, and gave to the three degrees of mortality the designations "village," "mean," and "city." The names of the two extreme classes were indicative of extreme rarity or extreme density of population; the intermediate term was used to indicate either a population of mean density, or the aggregate population independent of density.

Both Mr. Neison and Mr. Finlaison have, in their observations, made an important subdivision of the residents of rural districts into two classes, whose mortalities differ from one another in as great a degree as the mortality of town districts differs from that of rural districts in general. One of these two subdivisions is a class consisting chiefly of agricultural labourers; the other sub-

division is a class consisting of the residue of all residents in rural districts. According to both observations, the mortality of agricultural labourers is less than the mortality of the residue of the rural class in the proportion of 4 to 5, which is the relation of rural to town and of town to city mortality. Attempts have been made to subdivide the "town" and the "city" members of Friendly Societies into classes suffering similarly well marked different degrees of mortality; but, apparently, hitherto without success. This failure of the investigation so far as regards town and city districts, affords however no ground for doubting, what is evidently the fact, that the range of mortality between classes occupying the extremes of good health and bad health is much greater in city than it is in rural districts.

The mortality experienced by members of Friendly Societies resident in "city" districts, according to the observations of Messrs. Neison, Finlaison, and Ratcliffe, approaches nearly to the mortality of the male population of large towns of England of the healthiest class, such as York, Sunderland, Plymouth, Brighton, &c. (See Table II., p. 144; and the *Lancet*, vol. i. 1850, p. 330.) The result has been obtained by combining together the members of Friendly Societies resident in large towns of the first, second, and third degrees of health. Liverpool and Manchester represent large towns or cities of the third or lowest degree of health in England—the mortality of these large towns being 50 per cent. greater at most ages than that of the healthiest class of large towns just mentioned; and 100 per cent. greater than the mortality of the four healthiest Registrar's divisions, which comprehend one third part of the total population of England. It may also be seen, on comparing together the first and last columns of Table II., that the least mortality observed between the ages of 35 and 65 years is one third part only of the greatest mortality observed in England at the same interval of age—the least mortality being that of agricultural labourers, observed by Mr. Neison. The true range of mortality is, however, considerably greater than the observed range of 1 to 3; for it is nearly certain that, in all towns of great magnitude, there exist two large classes, occupying the extremes of good and bad health, one of which suffers a mortality one third less, and the other a mortality one third greater, than the average mortality of the whole population of the town; whence we are justified in concluding that, in the least healthy class of large towns of England, there exists a considerable portion of the population suffering a mortality four times as great as that which has been observed to exist in a class formed by selection from agricultural labourers.

All three observers, in their statements of "city" mortality at ages above 55 years, agree in presenting a similar anomaly. According to all three statements, city mortality is considerably greater than town mortality at all ages under 55 years, whilst at ages above 55 years the relation is reversed, though in a less degree. On inspection, however, of the three last columns of Table II., exhibiting the rates of mortality according to age of three classes of the largest towns of England, arranged according to their degrees of healthiness, there will be found no such anomalous appearance. It will there be seen, that at ages above 55 years the unhealthiness of either class of towns is as strongly indicated by increased mortality, as it is at ages below 55 years. There is thus no countenance afforded to the paradox presented by Messrs. Neison, Finlaison, and Ratcliffe—that as the unhealthiness of large towns increased, the mortality of the population at ages above 55 years proportionally diminished.

The anomalous appearance in question is probably attributable to the mixing together in one observation of classes resident in cities, whose mortalities are widely different. All three observers have formed their "city" class out of residents in large towns whose mortalities, for their total populations, differed from one another as much as 50 per cent., as already stated. In the case of such combination of two classes differing greatly in mortality, the result exhibited at the early ages will be the mean of the rates of mortality for the healthy and the unhealthy parts of the population. At the higher ages, however, the rate of mortality belonging to the healthier portion of the population will alone appear, by reason of the previous extinction by death of the portion subject to the higher of the two rates of mortality. The error arising from defective classification is much greater in city than it is in town or rural populations; but it can never be altogether avoided. In deducing the mortality of the total population of England, a defect of the nature alluded to must exist through the difficulty of forming classes of people whose mortalities are nearly on an equality. The mortality of a combination of correctly constituted classes will never increase according to age so rapidly as the mortality of the classes observed separately would increase. In the total male population of England, the line which apparently divides the period of florescence from that of senescence is at the age of 53 years. It is not improbable that the true line of division for the separate classes is at 51 years of age, the difference of two years being the effect of the combination of various classes whose amalgamation is necessarily imperfect.

It has already been stated that sickness, in duration for each

year of life, increases with the age, according to the same law which regulates the increasing proportion of deaths to the number living at successive ages. From the unity of law between sickness and death in relation to life, it necessarily follows that the sickness endured at any age bears a constant proportion to the deaths at any specified age. This proportion is commonly found to be, that of two years of sickness to one death. Occasionally this proportion is as low as one year and three quarters, and as high as two years and a half, of sickness to each death. In addition to the law determining the duration of sickness at each age, there is another law, which connects together the number of attacks or cases of sickness with the number of deaths, and consequently with the number of living, and with the duration of sickness at each year of age. The law which regulates the attacks of sickness was first communicated to the public in *The Lancet* of the year 1836 (vol. i., p. 855), in an article wherein I showed, from recent observations, that the fatality of cases or attacks of sickness increased with the age according to the law which regulates the increase of mortality and the increase of duration of sickness for each year of life. I then stated it to be an inevitable consequence of the identity of the numbers regulating the proportion of attacks of sickness to deaths, of duration of sickness to life, and of deaths to life at each age, that the number of annual attacks of sickness for a given number living was the same at all ages, and that the duration of each attack of sickness increased with the age in the same degree as the mortality increased.

The most interesting and remarkable of the above laws of sickness is that which makes the proportion of annual attacks of sickness to the number living constant at all ages. Notwithstanding its extreme simplicity, the existence of such a law does not appear to have been suspected previous to its announcement; nor did there exist, at that time, any facts which could be appealed to as supplying direct evidence of its existence. The public were subsequently indebted to Dr. Farr for adducing facts directly proving the constancy of the proportion of the numbers attacked by sickness to the number living at various ages of adult life. In the returns from Friendly Societies published by Mr. Neison and Mr. Finlaison, a great multitude of facts have been collected in further corroboration of the proportion of attacks of sickness being constant, and independent of age—at least in the period of florescence. According to Mr. Neison, the constant proportion of living persons attacked by sickness, in any year between 20 and 50 years of age, is 22 per cent. According to Mr. Finlaison, the constant proportion is 24

per cent. in each year. In both observations there is a depression of about 2 per cent. in the attacks near the age of 33 years, which is the age at which the greatest number of admissions of new members occurs; and which consequently is the age at which "selection" might be expected to have the greatest disturbing effect, whether on sickness or on mortality.

In the period of senescence, or at ages exceeding 50 years, the facts bearing on the laws of sickness (whether of attacks or of duration) are everywhere imperfectly recorded, on account of the difficulty of distinguishing cases of sickness from cases of debility from old age. Judging from all observations hitherto made, there appears to be no ground for doubting that the law of attacks, like the law of duration, of sickness, is continuous throughout the two periods of "floreescence" and "senescence," or from the earliest to the most advanced age of adult life. The returns of Mr. Neison are not available for the purpose of determining whether the proportion of attacks of sickness is constant at advanced ages, as well as at ages under 50 years, because no attempt has been made to distinguish therein sickness from old age; but the returns of Mr. Finlaison, which professedly represent pure sickness, free from cases of debility from old age, are sufficient for the present purpose. There is, however, a preliminary correction to be made in the numbers which Mr. Finlaison takes to represent attacks of sickness, which correction is of small amount at ages below 50 years, but is of great magnitude at very advanced ages. Mr. Finlaison assumes the number of persons who have been on the sick list in the course of the year to represent the number of new attacks of sickness in the year. This assumption is obviously incorrect, for in such list is included the cases of sickness remaining at the end of the previous year, and transferred to the new year. The number of such transferred old cases of sickness is represented by the proportion of living constantly sick at the particular year of age, which is the correction to be applied in diminution of Mr. Finlaison's alleged numbers of attacks. For example: according to Mr. Finlaison's tables, and taking decennial intervals of age, the proportions constantly sick at the ages 50 and 80 years, respectively, are $3\frac{1}{4}$ and 26 per cent. Also, according to the same tables, the annual proportion of persons on the sick list is $26\frac{1}{4}$ per cent. at the age of 50 years, and 56 per cent. at the age of 80 years. If we subtract from the latter numbers the corrections previously given, we obtain the numbers 23 and 30 per cent. as the corrected per centage of new annual attacks at the respective ages of 50 years and 80 years. These two numbers approach sufficiently near to each other to

warrant the presumption that a defect in the observation is the cause of the failure to obtain an exact coincidence. The apparent excess of attacks at the age of 80 years is in all probability owing to the complication of debility from old age with cases of sickness. Seven out of thirty cases of sickness would not have had the visible effect of producing incapacity for labour, if the man of 80 had not been subject to a debility from which the man aged 50 was comparatively free.

On inspection of Table III., it will be seen that at the mean age of 40 years the rate of sickness obtained by combining all three observations is 1·17 weeks to one year (or 52 weeks) of life, which is the same thing as 2·24 years of sickness to 100 years of life, or 2·24 per cent. of the living constantly sick. From the same table it will be seen that the mean number of deaths at the same age, according to the same combined observations, was 1·02 in one year out of every 100 people living. There was consequently 2·24 years of sickness to 1·02 deaths, or 2·20 years of sickness to one death. This relation of sickness to death remains constant when other ages are compared in the assumed observation representing the mean of all three observations.

The relation of sickness to death, which is constant for different ages in the same observation, is subject to variation in different observations. For example: in rural districts, the proportion of sickness to one death, at every age, is found to be 2·52 years, when the average of all three observers is taken; whilst in town and city districts, the averages similarly obtained are 2·29 and 1·92 years of sickness to one death. This result, from combining the three observations on each of the three districts, is not, however, in accord with the separate observations, for Mr. Finlaison states the disproportion between rural and city sickness to one death to be much greater than the disproportion stated by the other two observers.

The present three observations, when closely investigated, do not however either of them make good the proposition, that the quantity of true sickness to one death is less in cities than it is in rural districts. Mr. Finlaison, in showing the effect of "heavy" labour in increasing the apparent sickness, has supplied a cause sufficient to account for the apparent excess of rural sickness over town and city sickness. The apparent sickness, according to Mr. Finlaison, depends in a great measure on the occupation or labour of members being "heavy" or "light." He has shown, that at any given age, whether in rural or city districts, whether the mortality is high or low, the apparent sickness is 20 per cent. greater

for heavy than it is for light labour. In the two cases, the real amount of sickness is probably the same; but the incapacity for labour, or apparent sickness, is 20 per cent. greater in the case of heavy labour. This excess probably arises from minor degrees of sickness, which are sufficient to incapacitate for heavy, but not for light, labour. The proportion of "heavy" labour is much greater in rural than in city districts. We have thus a reason for expecting more apparent sickness in the former than in the latter districts. The cause now mentioned, when taken in combination with the opposite methods of treating superannuation, is also sufficient to account for the disproportion of rural to city sickness being greater according to Mr. Finlaison than it is according to the other two observers; for a considerable proportion (one fourth part) of the sickness exhibited in the tables of Mr. Neison and Mr. Ratcliffe consists of the life-time of superannuated members, who do not engage in labour, whether heavy or light. On the other hand, Mr. Finlaison, in his tables, takes no account of superannuation, except to exclude it from any connection with sickness. It thus happens that all Mr. Finlaison's recorded sickness is affected by the distinction of heavy and light labour, whilst three fourths only of the sickness recorded by Mr. Neison and Mr. Ratcliffe is so affected.

The laws of mortality, of sickness, and of health, may be said to be the three chief regulators of human life. It has been already shown, that there exists such a parallelism between the two laws of mortality and sickness (in duration), that when the mortality at any age is known, the sickness at the same age is also known, by means of the existing constant relation of sickness to death at all ages (about two years of sickness to one death). It remains to be seen that the degrees of health at different ages also bear a simple and constant relation to the mortality. It is first to be noticed, that health-time, being that portion of a man's life-time which is not sick-time, will of course decrease with the age as sick-time increases; so that, at very advanced ages, sick-time and health-time will form nearly equal portions of a man's life-time. At the early ages, however, of adult life, the proportions of health-time to life-time decrease so slowly, that, for the purpose of estimating the amount of health enjoyed at any age between 20 and 50 years, the element of time may with propriety be neglected, and the degree or intensity of health be alone regarded. On reflection it will be easily perceived that the degree of health possessed at any age is identical or synonymous with the vital force possessed at that age. The mortality is the inverse measure of the vital force, and is consequently the inverse measure also of the intensity of health.

For the purpose of illustrating the combined effects of the laws of mortality, sickness, and health, let any two ages in the period of "florescence," differing from each other by the interval of 24 years, itself. For example: if the mortality, sickness, or health, be numerically expressed for the age 20 years, we have only to multiply be taken, this being the interval in which the mortality doubles such mortality or such sickness by 2, in order to obtain the numbers expressing the mortality and sickness respectively as existing at the age 44 years. Similarly, the intensity of health at the age 44 years is obtained by dividing by 2 the number expressing intensity of health enjoyed at the age of 20 years. If, instead of comparing people of different ages in the same class of population, we compare people of the same age in different classes of population, whereof the mortalities differ in the proportion of 1 to 2, we obtain the same results as those just stated; if the mortality is increased 100 per cent., the sickness will be simultaneously increased 100 per cent., and the intensity of health reduced 50 per cent. Sickness and death are unquestionable evils, which increase as the force of life or health decreases; additions to intensity of life or health are unquestionable benefits, because they have the effect of diminishing unquestionable evils. Independently of these unquestionably beneficial effects, there is ground for assuming that life or health is intrinsically a benefit: whence it would follow, that additions to intensity of life, or robustness of health, must also be benefits. If the intensity of life or health be doubled, there is nothing to oppose the conclusion that the intrinsic benefit, pleasure, or happiness, is also doubled.

All three observers have devoted much of their attention to investigations of the mortality of members of Friendly Societies, classed according to occupation, with a view to discover the effect of any particular branch of labour or occupation in prolonging or shortening the duration of life. So far as regards the great majority of branches of labour examined, the comparative results elicited by the three observers are unsatisfactory, since they fail to exhibit any principle of classification applicable to trades in general. In one important respect, however, the three observers are nearly agreed, viz., as to the two classes which occupy the extremes of the scale of vitality. The highest rank is occupied by agricultural labourers; the lowest rank is occupied by those in the occupation of clerks. The highest degree of vitality belongs to the class whose corporeal powers are most exercised; the lowest degree of vitality belongs to the class whose corporeal powers are least exercised. According to the observations of both Mr. Neison and Mr. Rat-

cliffe, the vitality of clerks is lower than that of painters, potters, and miners; that is to say, an occupation involving no corporeal labour is apparently more detrimental to life than occupations involving corporeal labour in a poisoned atmosphere.

According to the observation of Mr. Finlaison, "heavy" labour in rural districts is attended by increased vitality, whilst in town and city districts heavy labour has no similar advantage over light labour. This opposition of results is open to question on the ground of imperfect classification of the trades taken as the constituents of heavy labour and light labour respectively. A large proportion of the trades carried on in towns and cities has been classed by Mr. Finlaison as heavy labour, although confined to the hands and arms, and involving little exercise of the chief or lower limbs of the body. Such labour cannot, with reason, be considered as the counterpart of the unmistakably "heavy" labour of the agriculturist. It is highly probable that, if the distinction between heavy labour and light labour were as well marked in towns and cities as it is in rural districts, a similar advantage would be shown to exist in all three cases in favour of the vitality of the classes whose labour is "heavy."

The amount of bodily labour undergone, or muscular force exerted, by any particular class of labourers, appears to afford a correct index of the vitality of that class. This principle, which has been shown to be applicable to the opposite extremes (agriculturists and clerks) in the scale of vitality, would probably be found applicable to the intermediate classes, if they could be arranged in well marked grades of labour undergone. This principle, when applied to the aggregate of trades collected in rural, town, and city districts respectively, will serve to explain why the vitality of rural is greater than that of town populations, and that of town greater than the vitality of city populations; for it cannot be doubted that the average amount of labour undergone by each man is greater in rural than in town, and in town greater than in city, districts. The disparity in the vitalities of the rural, town, and city populations would be greater than that observed if the native residents alone of rural, town, and city districts had been compared; for there is a great interchange of population by migration between rural and town districts, and between rural and city districts, whilst at the same time the balance of gain by migration is always against rural districts, and in favour of town and city districts. This transfusion of the rural element unduly elevates the vitality belonging to the native populations of towns and cities, at the expense of the vitality belonging to natives of rural districts. If such recruiting

from rural districts were stopped, the population of a large city, in however healthy a locality, would, in no long period of time, become unable to maintain its members by propagation.*

When classes of people engaged in different occupations are compared, there appears to be no reason for doubting that the vitality of each class is proportional to the amount of labour performed by that class. It is only when single individuals of the same or different classes are compared that the principle is found to be inapplicable. The vitality of an average agricultural labourer is greatly superior to that of an average clerk; but there are many clerks who possess a greater degree of vitality than that of an average agricultural labourer. An agricultural labourer commonly exercises his power of labour to its full extent; whilst many a clerk, possessing a great power of labour, does not exercise that power. In the former case, labour undergone and capacity for labour are almost exact measures of one another; but in the latter case, the labour of an individual is no index of his capacity for labour. Amongst individuals engaged in the same occupation, it may be said, with great appearance of truth, that the vital force of each is proportional to his capacity for labour. Having arrived at this principle, governing the vitality of the members of any one trade, there appears to be no obstacle to the extension of the principle to individuals of different trades, when compared together, and to say generally, that the vitality of any individual is proportional to his capacity for labour. In the majority of occupations (excluding that of agricultural labourers), the capacity for labour is generally in excess of the labour actually performed; but the proportional excess is probably nearly the same in most trades, whilst the excess itself has a continual tendency to diminution. This tendency is a consequence of the general law, that capacity for labour increases with the full exercise of that capacity, but diminishes when that capacity is insufficiently exercised.

The vital force of any human being is closely and almost inseparably connected with the capacity for muscular exertion. The greater the muscular force, the greater the vital force—a conclusion which might be arrived at without the aid of statistical observations of the number living and dying. Nearly all the known elements of animal vitality are included or involved in the capacity for hard labour.

* Since the above remarks were written, the Commissioners of the Census of 1851 have published their Report, exhibiting for the first time the birthplaces of the English population. It is there shown, that out of every 100 adult persons resident in London and 61 other large towns of England, only 40 were resident in the towns wherein they were born; whilst of the remaining 60 immigrants, 20 were born in other parts of the counties in which they reside, 30 were born in other counties of England, and 10 were born in Ireland and Scotland.

The animal organization is tasked to its full extent by hard labour ; if any of the principal organs be unsound, hard labour will prove the defect. The capacity for long continued hard labour cannot exist without powerful digestive and respiratory organs, a great strength of muscular fibre, and nearly all other known elements of strong vitality.

The vital force of mankind (and probably of animals in general) is subject to a composite law, consisting of three parts, one of which is immutable, and the other two variable, and capable of being influenced by human agency. The constant annual rate of increase of the vital force throughout the period of "childhood," the constant annual rate of decay of the vital force during the period of "florescence," or reproduction, and the greater constant annual rate of decay of the vital force during the period of "senescence," are in all probability immutable quantities which, like the law of gravitation, form part of the foundations of the universe. The second part of the composite law consists in the extent of the two periods of childhood and florescence respectively. In different masses of population, and in the same mass at different times, the extent of the period of childhood has been known to vary so much as three years, and the extent of the period of florescence so much as ten years. The cause of these variations is yet unknown. If the cause, when discovered, should prove to be under the control of human agency, the extent of these periods may be permanently prolonged, of which the effect would be more than a proportional prolongation of human life. The third and last part of the composite law of vital force consists in the absolute amount of that force possessed at birth, or at any specified age, by the average individual of a class. This amount, in England, has been shown to vary so greatly, that there exist classes of population whose mortalities at the same age differ from each other in the high proportion of one to three. These great variations have been shown to have a close connection with degrees of bodily labour, and are apparently, to a great extent, under the control of human agency. Without any interference of man, the laws of nature operate to promote the increase of the classes possessing the higher degree of vitality, and to retard the increase of the classes possessing the lower degrees of vitality. It is, however, within the power of man greatly to aid the operations of nature, by offering additional rewards to the higher degrees of labour, and affording additional facilities for the increase of that part of the population which is now ascertained to possess the highest degree of vitality.

TABLE I.

Showing, for Quinquennial Intervals of Age, the Rates of Mortality and Sickness experienced by Members of Friendly Societies, according to three several Observations; with which are compared the Results from Five Theoretical Tables, one of which represents the Annual Mortality of the Total Male Population of England, according to the latest Observations.

Age.	MORTALITY (per Cent. per Annum).					SICKNESS (in Weeks to One Year of Life).					
	FINLAISON.	NEISON.	RATCLIFFE.	Theoretical. Limit at 53 Years of Age.	Theoretical. Limit at 46 Years of Age.	Theoretical. Limit, 53. Total Male Population of England.	FINLAISON.	NEISON.	RATCLIFFE.	Theoretical. Limit, 53.	Theoretical. Limit, 45.
20to25	.73	.68	.76	.61	.65	.77	Weeks. .98	Weeks. .86	Weeks. .70	Weeks. .72	Weeks. .72
25—30	.76	.73	.81	.71	.75	.89	.99	.90	.77	.84	.84
30—35	.80	.80	.88	.82	.87	1.03	.98	.92	.86	.97	.97
35—40	.95	.88	.93	.95	1.01	1.19	1.12	1.07	.98	1.12	1.12
40—45	1.11	1.03	1.23	1.10	1.17	1.38	1.25	1.34	1.23	1.30	1.30
45—50	1.36	1.26	1.48	1.28	1.47	1.60	1.50	1.72	1.62	1.51	1.70
50—55	1.73	1.68	2.18	1.52	2.14	1.90	1.86	2.32	2.20	1.79	2.49
55—60	2.52	2.22	2.83	2.13	3.14	2.66	2.32	3.28	3.48	2.51	3.66
60—65	2.98	2.93	4.58	3.12	4.61	3.90	3.35	5.50	5.77	3.68	5.37
65—70	4.81	4.49	6.86	4.58	6.76	5.72	5.06	11.13	6.93	5.40	7.88
70—75	6.66	7.09	6.72	6.72	9.92	8.40	8.47	18.40	13.55	7.92	11.55
25to35	.78	.77	.84	.76	.81	.96	.98	.91	.82	.90	.90
35—45	1.03	.95	1.08	1.03	1.09	1.28	1.18	1.21	1.10	1.21	1.21
45—55	1.54	1.47	1.83	1.40	1.81	1.75	1.68	2.02	1.91	1.65	2.09
55—65	2.75	2.57	3.70	2.62	3.87	3.28	2.84	4.39	4.62	3.09	4.51
65—75	5.74	5.79	..	5.65	8.34	7.06	6.76	14.77	10.24	6.66	9.71

TABLE II.
Showing, for Decennial Intervals of Age, the Rates of Mortality observed amongst the Members of Friendly Societies resident in Rural, Town, and City Districts; with which are compared the Mortality of the whole and of parts of the Male Population of England.

AGE.	Labourers in Rural Districts.	Out-door Heavy Labour in Rural Districts.	Theoretical. Limit at 51 Years of Age.	RURAL DISTRICTS.			All in Rural Districts, except Labourers.	In-door Light and Heavy Labour in Rural Districts.	Male Population of England.		Theoretical. Limit at 53 Years of Age.
	NEISON.	FINLAISON.		NEISON.	FINLAISON.	RATCLIFFE.	NEISON.	FINLAISON.	Four Healthiest Registrar's Divisions. Nos. 2, 4, 5, & 11.	Total Population. Eleven Registrar's Divisions.	
25 to 35	.57	.64	.64	.71	.72	.76	.78	.85	.95	.97	.96
35—45	.70	.78	.86	.80	.86	.91	.86	.98	1.07	1.25	1.28
45—55	1.03	1.24	1.20	1.24	1.32	1.50	1.41	1.61	1.48	1.78	1.75
55—65	1.75	2.34	2.40	2.22	2.51	3.44	2.60	2.75	2.65	3.14	3.22
65—75	4.58	4.84	5.17	5.27	5.34	..	5.55	6.08	5.83	6.61	6.78

TABLE II.—Continued.

AGE.	Theoretical. Limit at 48 Years of Age.	TOWN DISTRICTS.				CITY DISTRICTS.				Theoretical. Limit at 53 Years of Age.	POPULATION OF CITIES OF ENGLAND.		
		NEISON.		FINLAISON.	RATCLIFFE.	NEISON.		FINLAISON.	RATCLIFFE.		Twelve of Healthiest Class.	Eight of less Healthy Class.	Liverpool and Manchester.
		NEISON.	FINLAISON.			NEISON.	RATCLIFFE.						
25 to 35	·77	·75	·80	·76	·98	1·02	·98	1·06	1·08	1·12	1·28		
35—45	1·03	·97	1·10	1·04	1·43	1·54	1·38	1·41	1·43	1·62	2·07		
45—55	1·57	1·67	1·71	1·66	1·99	2·04	2·51	1·92	2·06	2·42	3·20		
55—65	3·32	3·36	2·94	4·06	3·20	3·22	2·94	3·54	3·55	4·26	5·27		
65—75	7·15	7·69	6·48	..	6·61	5·62	..	7·46	7·06	8·47	10·39		

TABLE III.

Showing, for Decennial Intervals of Age, the Rates of Sickness in Rural, Town, and City Districts, according to each of three Observers; also showing the Mean Rates of Sickness and Mortality in each of the same three Districts, for comparison with the Results of Theoretical Tables, in all of which the period of "Senescence" commences at the Age of 48 Years.

AGE.	RURAL DISTRICTS.			TOWN DISTRICTS.			CITY DISTRICTS.			MEAN OF THREE OBSERVATIONS.		
	FINLAISON.		NEISON.	RATCLIFFE.		FINLAISON.	NEISON.	RATCLIFFE.	Rural.	Town.	City.	
	Weeks.		Weeks.	Weeks.		Weeks.	Weeks.	Weeks.	Weeks.	Weeks.	Weeks.	
	Weeks.	Weeks.	Weeks.	Weeks.	Weeks.	Weeks.	Weeks.	Weeks.	Weeks.	Weeks.	Weeks.	
25 to 35	1.02	.87	.89	.78	.83	.90	1.11	.84	.89	.89	.95	
35—45	1.19	1.08	1.30	.99	1.08	1.18	1.50	1.28	1.09	1.19	1.32	
45—55	1.61	1.65	2.62	1.76	1.80	1.68	2.46	2.26	1.67	2.07	2.13	
55—65	2.78	4.08	5.17	4.54	4.10	2.63	4.63	5.58	3.80	4.09	4.28	

TABLE III.—Continued.

AGE.	SICKNESS.—Observed. Mean of Three Observations of all Three Districts.			SICKNESS.—Theoretical. Corresponding to Mean of Three Observations.			MORTALITY.—Observed. Being Mean of the Three Observations.			MORTALITY.—Theoretical. Corresponding to Mean of Three Observations.		
	Rural.		City.	Town.		Weeks.	Rural.		Town.	Rural.		Three Districts.
	Weeks.	Weeks.	Weeks.	Weeks.	Weeks.	Weeks.	Weeks.	Weeks.	Weeks.	Weeks.	Weeks.	Weeks.
25 to 35	.90	.84	1.02	.92	.77	.73	.99	.80	.77	.64	.77	.77
35—45	1.17	1.13	1.37	1.24	1.04	.86	1.45	1.02	1.37	.86	1.03	1.03
45—55	1.87	1.73	2.09	1.88	1.68	1.35	2.18	1.61	2.09	1.31	1.57	1.57
55—65	3.95	3.65	4.43	3.98	3.45	2.72	3.12	3.01	4.43	2.77	3.32	3.32

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